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| NSW Education Standards Authority |  |

**Science 7–10**

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# Science 7–10

## Implementation from 2026

The new Science 7–10 Syllabus (2023) is to be implemented from 2026.

**2024 and 2025** – Plan and prepare to teach the new syllabus

**2026** – Start teaching new syllabus

School sectors are responsible for implementing syllabuses and are best placed to provide schools with specific guidance and information on implementation given their understanding of their individual contexts.

## Aim

The aim of the *Science 7–10 Syllabus* is to:

* develop students’ curiosity about, and interest in, science and the natural world
* increase students’ knowledge and understanding of the nature and practice of science, and the Working scientifically processes
* encourage students to generate and analyse data, evaluate results, and make ethical, evidence-based decisions, as informed, reflective and scientifically literate citizens.

## Table of outcomes

*The table below displays the Science 7–10 focus areas and their associated outcomes. The relationship between Stage 4 and 5 and Life Skills outcomes is shown in the Related Life Skills column. Life Skills focus areas and their associated outcomes are listed in full in the Life Skills section of the syllabus.*

### Secondary (7–10)

| **Focus area** | **Stage 4** | **Stage 5** |
| --- | --- | --- |
| **Working scientifically** | **SC4-WS-01 Working scientifically Observing**  uses scientific tools and instruments for observations  **SC4-WS-02 Working scientifically Questioning and predicting**  identifies questions and makes predictions to guide scientific investigations  **SC4-WS-03 Working scientifically Planning investigations**  plans safe and valid investigations  **SC4-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe and valid investigations  **SC4-WS-05 Working scientifically Processing data and information**  uses a variety of ways to process and represent data  **SC4-WS-06 Working scientifically Analysing data and information**  uses data to identify trends, patterns and relationships, and draw conclusions  **SC4-WS-07 Working scientifically Problem-solving**  identifies problem-solving strategies and proposes solutions  **SC4-WS-08 Working scientifically Communicating**  communicates scientific concepts and ideas using a range of communication forms | **SC5-WS-01 Working scientifically Observing**  selects and uses scientific tools and instruments for accurate observations  **SC5-WS-02 Working scientifically Questioning and predicting**  develops questions and hypotheses for scientific investigation  **SC5-WS-03 Working scientifically Planning investigations**  designs safe, ethical, valid and reliable investigations  **SC5-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe, ethical, valid and reliable investigations  **SC5-WS-05 Working scientifically Processing data and information**  selects and uses a range of tools to process and represent data  **SC5-WS-06 Working scientifically Analysing data and information**  analyses data from investigations to identify trends, patterns and relationships, and draws conclusions  **SC5-WS-07 Working scientifically Problem-solving**  selects suitable problem-solving strategies and evaluates proposed solutions to identified problems  **SC5-WS-08 Working scientifically Communicating**  communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms |
| **Observing the Universe** | **SC4-OTU-01**  explains how observations are used by scientists to increase knowledge and understanding of the Universe  **SC4-WS-01 Working scientifically Observing**  uses scientific tools and instruments for observations  **SC4-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe and valid investigations | No Stage 5 outcomes |
| **Forces** | **SC4-FOR-01**  describes the effects of forces in everyday contexts  **SC4-WS-02 Working scientifically Questioning and predicting**  identifies questions and makes predictions to guide scientific investigations  **SC4-WS-05 Working scientifically Processing data and information**  uses a variety of ways to process and represent data  **SC4-WS-06 Working scientifically Analysing data and information**  uses data to identify trends, patterns and relationships, and draw conclusions  **SC4-WS-07 Working scientifically Problem-solving**  identifies problem-solving strategies and proposes solutions | No Stage 5 outcomes |
| **Cells and classification** | **SC4-CLS-01**  describes the unique features of cells in living things and how structural features can be used to classify organisms  **SC4-WS-01 Working scientifically Observing**  uses scientific tools and instruments for observations  **SC4-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe and valid investigations  **SC4-WS-08 Working scientifically Communicating**  communicates scientific concepts and ideas using a range of communication forms | No Stage 5 outcomes |
| **Solutions and mixtures** | **SC4-SOL-01**  explains how the properties of substances enable separation in a range of techniques  **SC4-WS-03 Working scientifically Planning investigations**  plans safe and valid investigations  **SC4-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe and valid investigations  **SC4-WS-07 Working scientifically Problem-solving**  identifies problem-solving strategies and proposes solutions | No Stage 5 outcomes |
| **Living systems** | **SC4-LIV-01**  describes the role, structure and function of a range of living systems and their components  **SC4-WS-02 Working scientifically Questioning and predicting**  identifies questions and makes predictions to guide scientific investigations  **SC4-WS-05 Working scientifically Processing data and information**  uses a variety of ways to process and represent data  **SC4-WS-08 Working scientifically Communicating**  communicates scientific concepts and ideas using a range of communication forms | No Stage 5 outcomes |
| **Periodic table and atomic structure** | **SC4-PRT-01**  explains how uses of elements and compounds are influenced by scientific understanding and discoveries relating to their properties  **SC4-WS-05 Working scientifically Processing data and information**  uses a variety of ways to process and represent data  **SC4-WS-06 Working scientifically Analysing data and information**  uses data to identify trends, patterns and relationships, and draw conclusions | No Stage 5 outcomes |
| **Change** | **SC4-CHG-01**  explains how energy causes geological and chemical change  **SC4-WS-01 Working scientifically Observing**  uses scientific tools and instruments for observations  **SC4-WS-03 Working scientifically Planning investigations**  plans safe and valid investigations  **SC4-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe and valid investigations | No Stage 5 outcomes |
| **Data science**  Includes:  Stage 4: Data science 1  Stage 5: Data science 2 | **SC4-DA1-01**  explains how data is used by scientists to model and predict scientific phenomena  **SC4-WS-06 Working scientifically Analysing data and information**  uses data to identify trends, patterns and relationships, and draw conclusions  **SC4-WS-07 Working scientifically Problem-solving**  identifies problem-solving strategies and proposes solutions | **SC5-DA2-01**  assesses the use of scientific knowledge and data in evidence-based decisions and when verifying the legitimacy of claims  **SC5-WS-06 Working scientifically Analysing data and information**  analyses data from investigations to identify trends, patterns and relationships, and draws conclusions  **SC5-WS-07 Working scientifically Problem-solving**  selects suitable problem-solving strategies and evaluates proposed solutions to identified problems  **SC5-WS-08 Working scientifically Communicating**  communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms |
| **Energy** | No Stage 4 outcomes | **SC5-EGY-01**  evaluates current and alternative energy use based on ethical and sustainability considerations  **SC5-WS-01 Working scientifically Observing**  selects and uses scientific tools and instruments for accurate observations  **SC5-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe, ethical, valid and reliable investigations  **SC5-WS-07 Working scientifically Problem-solving**  selects suitable problem-solving strategies and evaluates proposed solutions to identified problems |
| **Disease** | No Stage 4 outcomes | **SC5-DIS-01**  explains how an understanding of the causes of disease can be used to prevent and manage the spread of disease  **SC5-WS-06 Working scientifically Analysing data and information**  analyses data from investigations to identify trends, patterns and relationships, and draws conclusions  **SC5-WS-08 Working scientifically Communicating**  communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms |
| **Materials** | No Stage 4 outcomes | **SC5-MAT-01**  assesses the uses of materials based on their physical and chemical properties  **SC5-WS-03 Working scientifically Planning investigations**  designs safe, ethical, valid and reliable investigations  **SC5-WS-07 Working scientifically Problem-solving**  selects suitable problem-solving strategies and evaluates proposed solutions to identified problems  **SC5-WS-08 Working scientifically Communicating**  communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms |
| **Environmental sustainability** | No Stage 4 outcomes | **SC5-ENV-01**  analyses the impact of human activity on the natural world  **SC5-WS-06 Working scientifically Analysing data and information**  analyses data from investigations to identify trends, patterns and relationships, and draws conclusions  **SC5-WS-07 Working scientifically Problem-solving**  selects suitable problem-solving strategies and evaluates proposed solutions to identified problems |
| **Genetics and evolutionary change** | No Stage 4 outcomes | **SC5-GEV-01**  describes the relationship between the diversity of living things and the theory of evolution  **SC5-GEV-02**  explains how DNA is responsible for the transmission of heritable characteristics and can be manipulated through genetic technologies  **SC5-WS-05 Working scientifically Processing data and information**  selects and uses a range of tools to process and represent data  **SC5-WS-08 Working scientifically Communicating**  communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms |
| **Reactions** | No Stage 4 outcomes | **SC5-RXN-01**  describes a range of reaction types  **SC5-RXN-02**  explains the factors that affect the rate of chemical reactions  **SC5-WS-01 Working scientifically Observing**  selects and uses scientific tools and instruments for accurate observations  **SC5-WS-02 Working scientifically Questioning and predicting**  develops questions and hypotheses for scientific investigation  **SC5-WS-03 Working scientifically Planning investigations**  designs safe, ethical, valid and reliable investigations  **SC5-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe, ethical, valid and reliable investigations |
| **Waves and motion** | No Stage 4 outcomes | **SC5-WAM-01**  describes the features and applications of different forms of waves  **SC5-WAM-02**  explains the motion of objects using Newton’s laws of motion  **SC5-WS-04 Working scientifically Conducting investigations**  follows a planned procedure to undertake safe, ethical, valid and reliable investigations  **SC5-WS-05 Working scientifically Processing data and information**  selects and uses a range of tools to process and represent data |

Before deciding that a student should undertake a course based on Life Skills outcomes and content, consideration should be given to other ways of assisting the student to engage with the Stage 4 or Stage 5 outcomes. Further information in relation to planning, implementing and assessing Life Skills outcomes and content can be found on the [NESA website](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/diversity-in-learning/special-education/life-skills).

## Outcomes and content for Stage 4

### Working scientifically

#### Outcomes

A student:

* uses scientific tools and instruments for observations **SC4-WS-01**
* identifies questions and makes predictions to guide scientific investigations **SC4-WS-02**
* plans safe and valid investigations **SC4-WS-03**
* follows a planned procedure to undertake safe and valid investigations **SC4-WS-04**
* uses a variety of ways to process and represent data **SC4-WS-05**
* uses data to identify trends, patterns and relationships, and draw conclusions **SC4-WS-06**
* identifies problem-solving strategies and proposes solutions **SC4-WS-07**
* communicates scientific concepts and ideas using a range of communication forms **SC4-WS-08**

**Related Life Skills outcomes:** SCLS-WS-01, SCLS-WS-02, SCLS-WS-03, SCLS-WS-04, SCLS-WS-05, SCLS-WS-06, SCLS-WS-07, SCLS-WS-08

#### Content

##### Observing

* Make observations using the senses to compare properties of objects, living things and events
* Demonstrate competency when using scientific equipment to make observations
* Make relevant observations and measure quantities, including length, mass, temperature and volume
* Make a series of observations and measurements that are appropriate to answer a question that has been posed

##### Questioning and predicting

* Identify questions and problems that can be investigated scientifically
* Make predictions based on scientific knowledge and observations

##### Planning investigations

* Identify the purpose of an investigation
* Identify the independent, dependent and controlled variable(s)
* Identify the type of data that needs to be collected in a range of investigations
* Outline the method and equipment needed to undertake an investigation
* Outline steps to manage safety risks before, during and after an investigation

##### Conducting investigations

* Employ safe work practices and manage risks using work health and safety (WHS) practices
* Assemble and use appropriate equipment and resources to perform an investigation
* Follow the planned procedure, including the measurement and control of variables
* Record observations and measurements accurately, using correct units for physical quantities
* Use a wide range of reliable secondary sources and acknowledge their sources

##### Processing data and information

* Extract information from texts, diagrams, flow charts, tables, databases, graphs and multimedia resources
* Use a range of representations to organise data, including graphs, keys, models, diagrams, tables and spreadsheets
* Include sources, titles, labels and scales when displaying data in a graph
* Select the type of graph best suited to represent various single datasets and justify this choice
* Calculate the mean and range of a dataset
* Convert between units of measurement

##### Analysing data and information

* Assess the reliability of gathered data and information by comparing it to observations and information from other sources, including published scientific writing
* Identify patterns and relationships in graphs, keys, models, diagrams, tables and spreadsheets
* Identify data which supports or refutes a testable statement being investigated or a proposed solution to a problem
* Use scientific understanding to identify relationships and draw conclusions based on students’ data and secondary sources
* Propose inferences based on presented information and observations
* Evaluate the method used to investigate a question or solve a problem, including evaluating the quality of the data collected and identifying possible improvements to the investigation

##### Problem-solving

* Identify problems and devise possible strategies or solutions
* Use identified strategies to suggest possible solutions to a familiar problem
* Use given evaluation criteria to select optimal solutions to problems
* Identify cause-and-effect relationships and develop models to explain phenomena
* Evaluate the suitability of different strategies for solving an identified problem using given criteria

##### Communicating

* Present findings and ideas in a range of communication forms, including using relevant scientific terms, diagrams and graphical representations, as appropriate to audience and purpose
* Create written texts to communicate scientific concepts, ideas or investigations using conventional scientific text structures

### Observing the Universe

#### Outcomes

A student:

* explains how observations are used by scientists to increase knowledge and understanding of the Universe **SC4-OTU-01**
* uses scientific tools and instruments for observations **SC4-WS-01**
* follows a planned procedure to undertake safe and valid investigations **SC4-WS-04**

**Related Life Skills outcomes:** SCLS-OTU-01, SCLS-WS-01, SCLS-WS-04

#### Content

**Working scientifically**

In this focus area, students develop skills in making observations, using scientific tools to observe, and using a sequence of instructions to safely undertake a range of investigations. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Observing](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-f27d1490-503e-46a1-879f-363fec4184f5), [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-ff323f4e-b0af-4931-879e-81036e19cca0)

##### Nature of science

* Discuss that the purpose of science is to build knowledge and understanding of the world and the Universe through observation, experimentation and analysis
* Recognise how scientific knowledge can be represented in branches of biology, chemistry, physics and geology, and consider how modern scientific knowledge is interdisciplinary and transdisciplinary
* Explore why scientific research is usually collaborative and builds on the work of others
* Identify that scientific theories and laws are based on repeated experiments and observations that describe or predict a range of natural phenomena

##### Practice of science

* Identify that the practice of science involves using the Working scientifically processes
* Use a variety of analog and digital measuring devices in scientific investigations to compare the range, sensitivity and accuracy of observations provided by those instruments

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| **Example(s):**  Using the senses, a thermometer, digital scales, a stopwatch. |

* Compare and contrast the accuracy and reliability of observations made using the senses with those obtained using measuring equipment

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| **Example(s):**  Observations of a leaf or insect, made with the eye, compared to a microscope or a scanning electron microscope (SEM). |

* Explain how observations of natural phenomena can be used to make inferences and testable predictions
* Explore the different approaches scientists use in scientific research, including systematic observations and controlled experiments
* Follow a sequence of instructions to safely conduct an investigation, and use scientific tools and instruments to observe how changing the independent variable of the investigation can cause a change in its dependent variable
* Conduct an investigation using scientific tools and instruments to make a series of observations over time

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| **Example(s):**  The relationship between air temperature and relative humidity; temperature changes during the day in shaded and unshaded areas. |

* Tabulate and graph data from an investigation to identify trends, patterns and relationships, and draw conclusions

##### Space science

* Compare historical and current solar system models to show how models are modified or rejected due to new scientific evidence
* Explain that predictable and observable phenomena on the Earth are caused by the relative positions of the Sun, the Earth and the Moon
* Use physical models or virtual simulations to explain the cyclic patterns of lunar phases and eclipses of the Sun and Moon

##### Aboriginal and Torres Strait Islander Peoples’ Cultural Knowledges of astronomy

* Investigate the similarities between Aboriginal and Torres Strait Islander accounts and mainstream scientific explanations about the phases of the Moon and how the phases affect tides
* Explain how Aboriginal and Torres Strait Islander Peoples use stars to identify specific weather phenomena

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| **Example(s):**  Using the stars enables Aboriginal and Torres Strait Islander Peoples to predict weather patterns by observing the colour, brightness and twinkling of stars. The Wiradjuri People used the sky to predict rainfall along the Murrumbidgee River and the Meriam People use the twinkling of stars to indicate the change from hot season to wet season. |

* Describe how Aboriginal and/or Torres Strait Islander Peoples predicted seasonal phenomena based on their observations of the stars and phases of the Moon to predict animal behaviour, plant cycles and tidal changes

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| **Example(s):**  The Pitjantjatjara People use the star cluster when predicting when winter frost will begin; Torres Strait Islander Peoples see the yam star (Kek) as an indication of when to harvest yams. |

##### Observing the Universe in context

* Investigate how a recent advancement in science has increased knowledge of the world and the Universe

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| **Example(s):**  Advancements in the field of astronomy made by Australian scientists. |

### Forces

#### Outcomes

A student:

* describes the effects of forces in everyday contexts **SC4-FOR-01**
* identifies questions and makes predictions to guide scientific investigations **SC4-WS-02**
* uses a variety of ways to process and represent data **SC4-WS-05**
* uses data to identify trends, patterns and relationships, and draw conclusions **SC4-WS-06**
* identifies problem-solving strategies and proposes solutions **SC4-WS-07**

**Related Life Skills outcomes:** SCLS-FOR-01, SCLS-WS-02, SCLS-WS-05, SCLS-WS-06, SCLS-WS-07

#### Content

**Working scientifically**

In this focus area, students develop skills in identifying and developing questions for investigation, as well as processing and representing data, and identifying trends, patterns and relationships in data. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Questioning and predicting](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-2c2e8df0-8e99-4c98-b6f4-67f6d7b57e08), [Processing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-7d77e241-ccbe-4dfe-af35-5b0708d42909), [Analysing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-026b93d6-b1da-454c-a537-852180ad8fcf), [Problem-solving](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-b59220b0-28b4-49c0-9e22-69796d0d5ed5)

##### Forces in action

* Explain forces as either direct (contact) or indirect (non-contact)

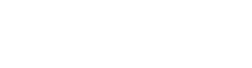
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| **Example(s):**  Direct, such as physical touch, friction.  Indirect, such as from magnetic, electrical or gravitational fields. |

* Conduct a practical investigation on the effects of a range of direct and indirect forces
* Use force diagrams to model balanced and unbalanced forces

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| **Example(s):**  Free-body diagrams showing all the forces acting on an object, including the force's direction and magnitude. |

* Analyse force diagrams to make predictions
* Examine the relationship between force and energy
* Describe the electrostatic and gravitational forces exerted between objects
* Use the concept of forces to describe the motion of objects in orbit

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| **Example(s):**  Planets in orbit around the Sun, planets in orbit around the centre of gravity, satellites in orbit around the Earth. |

* Define weight force as the mass the acceleration due to gravity () ()
* Perform calculations using the equation to solve for unknowns

##### Magnets in everyday life

* Describe how magnets attract or repel each other based on their polarity
* Conduct a practical investigation to test the effect of distance on the action of a magnet
* Observe and map the magnetic fields of magnets
* Conduct a practical investigation to construct electromagnets and compare their strength

##### Simple machines in everyday life

* Explore the role of simple machines, from now and in the past, as used in everyday life

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| **Example(s):**  A bike wheel (wheel and axle), crane (pulley), skateboard ramp (inclined plane), drill (screw), knife (wedge), using a spoon to open a can of paint (lever), woomeras used by Aboriginal Peoples, bow and arrows used by Torres Strait Islander Peoples. |

* Conduct a series of practical investigations using simple machines to investigate the action of forces
* Investigate how simple machines, such as levers and pulleys, are used to change the magnitude of force needed when performing a task
* Identify examples of Aboriginal and Torres Strait Islander Peoples’ application of Knowledge about forces

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| **Example(s):**  Aboriginal Peoples use forces as part of everyday life, such as grinding stones to make and/or sharpen tools or to crush plant material. |

* Investigate how simple machines can solve everyday issues

##### Forces in context

* Investigate examples of forces and magnetism in familiar contexts

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| **Example(s):**  Electromagnets in maglev trains; bicycles; children’s toys. |

### Cells and classification

#### Outcomes

A student:

* describes the unique features of cells in living things and how structural features can be used to classify organisms **SC4-CLS-01**
* uses scientific tools and instruments for observations **SC4-WS-01**
* follows a planned procedure to undertake safe and valid investigations **SC4-WS-04**
* communicates scientific concepts and ideas using a range of communication forms **SC4-WS-08**

**Related Life Skills outcomes:** SCLS-FNS-01, SCLS-FNS-02, SCLS-WS-01, SCLS-WS-04, SCLS-WS-08

#### Content

**Working scientifically**

In this focus area, students develop skills in using scientific tools and instruments for observations, as well as conducting investigations and communicating scientific ideas and concepts. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Observing](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-f27d1490-503e-46a1-879f-363fec4184f5), [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-ff323f4e-b0af-4931-879e-81036e19cca0), [Communicating](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-e30ee5b9-e7cf-44ed-8d39-a7a227af3a4c)

##### Classification of living things

* Describe the characteristics of living things
* Discuss the role and importance of classification in ordering and organising the diversity of life on Earth

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| **Example(s):**  Classifications including Animalia, Plantae, Fungi, Protista and Monera. |

* Classify species using scientific conventions from the binomial system of classification, including kingdom, phylum, class, order, family, genus and species

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| **Example(s):**  Human (*Homo sapiens*), bottlenose dolphin (*Tursiops truncatus*), snapping turtle (*Chelydra serpentina*), tapeworm (*Taenia solium*), golden wattle (*Acacia pycnantha*). |

* Conduct an investigation to observe and identify the similarities and differences of structural features within and between groups of organisms
* Investigate how organisms in an Australian habitat are adapted to their environment and document findings in a written scientific report
* Interpret dichotomous keys to identify organisms surveyed in an Australian habitat
* Explain how plants and animals are classified in Aboriginal and Torres Strait Islander Cultures based on their uses, forms and functions

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| **Example(s):**  Classification is based on Cultural significance and Kinship, and different Nations use specific methods of classification. The classification of wood-bearing plants may have the same names as the function of the finished object, such as spear trees, shield trees, canoe trees and resin trees. |

##### Cells

* Outline cell theory
* Identify which cell structures and organelles are common in plant and animal cells
* Describe the functions of the cell membrane, cytoplasm, nucleus containing DNA, mitochondria and chloroplasts
* Compare the structure of plant and animal cells to identify similarities and differences
* Conduct an investigation to observe and record the similarities and differences between different cells, including fungi, bacteria, plant and animal cells, using microscopes and/or images obtained from microscopes
* Identify cellular respiration via mitochondria, and photosynthesis via chloroplasts, as examples of important processes that take place in specialised organelles
* Draw single-celled organisms observed under a microscope

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| **Example(s):**  Diagrams could be drawn from first-hand observations under a microscope or by using images gathered from online sources or simulations. |

* Describe the role of specialised cells in multicellular organisms and explain why they are needed
* Represent the arrangement of specialised cells in tissues and in organs
* Examine the relationship between structure and function for a range of specialised cells

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| **Example(s):**  The shape and arrangement of cells in the small intestine allows for maximum surface area for absorption; red blood cells lack a nucleus which maximises their oxygen carrying capacity. |

* Conduct a practical investigation to observe and compare prepared slides of specialised cells

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| **Example(s):**  Muscle cells, such as skeletal muscle cells are long, cylindrical and striated; leaf cells, such as the Elodea leaf cell have a box-like shape with a cell wall and chloroplasts. |

##### Cells and classification in context

* Research an organism to explain its classification and describe how it embodies all the characteristics shared by living things

### Solutions and mixtures

#### Outcomes

A student:

* explains how the properties of substances enable separation in a range of techniques **SC4-SOL-01**
* plans safe and valid investigations **SC4-WS-03**
* follows a planned procedure to undertake safe and valid investigations **SC4-WS-04**
* identifies problem-solving strategies and proposes solutions **SC4-WS-07**

**Related Life Skills outcomes:** SCLS-SOL-01, SCLS-WS-03, SCLS-WS-04, SCLS-WS-07

#### Content

**Working scientifically**

In this focus area, students develop skills in planning and conducting investigations, as well as identifying problem-solving strategies and proposing solutions to problems. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Planning investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-0b1df83b-3056-4e12-be95-92bd29554af8), [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-ff323f4e-b0af-4931-879e-81036e19cca0), [Problem-solving](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-b59220b0-28b4-49c0-9e22-69796d0d5ed5)

##### Properties of matter

* Identify the 3 main states of matter and how they are represented in the movement of water on earth

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| **Example(s):**  Ice (solid), water (liquid), vapour (gas). |

* Conduct an investigation to measure and graph the temperature of water to identify the changes of state as heated over time

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| **Example(s):**  Heating ice until boiling and recording the temperature each minute (or using a data logger to track live) to graph the data and identify each change of state. |

* Represent changes in the state of matter in terms of particle arrangement and movement

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| **Example(s):**  Melting, freezing, boiling, evaporation, condensation, deposition, sublimation. |

* Compare the properties of matter in different states, including the relative strength of attractive forces between solid, liquid and gas particles, to explain differences in the behaviours of the 3 states of matter

##### Properties of water

* Investigate the other physical properties of water, such as density, buoyancy and surface tension
* Conduct a practical investigation and select appropriate equipment to measure the density of water and other substances, and record the results in a table to compare the calculated density with SI data

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| **Example(s):**  Density data for some common substances (refer to the Properties of some common elements table in the Science 7–10 Data Book). |

* Determine the volume and mass of regular-shaped and irregular-shaped objects to calculate their density using the formula

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| **Example(s):**  Density is equal to mass divided by volume: |

##### Solutions

* Investigate what substances dissolve in water and discuss findings using key terms, including soluble, insoluble, solubility, solute, solvent and solution
* Conduct and document a practical investigation to measure solubility of different solutes in water, and present data using tables and relevant graphs

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| **Example(s):**  Documenting a practical report could include the aim, apparatus, method, results and conclusion. |

* Qualitatively investigate the effect of temperature on solubility

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| **Example(s):**  Hot water can dissolve more sugar than cold water. |

* Describe how solutions can be modelled using particle theory
* Compare the properties of dilute, concentrated, saturated and supersaturated solutions

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| **Example(s):**  Prepare a range of dilutions from a coloured concentrated solution, such as food colouring or cordial, and compare the differences in colour intensity.  Calculate the concentration of dilutions using grams per litre (g/L), percentage volume per volume (% v/v). |

##### Separating mixtures

* Distinguish between atoms, mixtures and compounds and explain their properties using particle theory
* Classify matter as pure substances, including elements and compounds, and impure substances, including mixtures based on their particle composition

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| **Example(s):**  Mixtures, including homogeneous and heterogeneous mixtures. |

* Explain how the physical properties of substances are used to separate mixtures

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| **Example(s):**  Physical properties, including particle size, density, volatility.  Separation techniques, including filtration, evaporation, crystallisation, chromatography, decantation. |

* Conduct a series of practical investigations to explore common techniques to separate mixtures

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| **Example(s):**  Common techniques, including filtration, evaporation, crystallisation, distillation, centrifugation. |

* Investigate techniques used by Aboriginal and/or Torres Strait Islander Peoples to separate mixtures

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| **Example(s):**  Common techniques, including using wet and dry methods to extract components of mixtures, such as winnowing, yandying, hand-picking, sieving, filtering steam distillation, cold pressing. |

* Investigate an industrial separation technique

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| **Example(s):**  Recycling and water purification techniques. |

##### Solutions and mixtures in context

* Model how a body of water can become polluted, and plan and conduct a practical investigation that attempts to remove the pollutants

### Living systems

#### Outcomes

A student:

* describes the role, structure and function of a range of living systems and their components **SC4-LIV-01**
* identifies questions and makes predictions to guide scientific investigations **SC4-WS-02**
* uses a variety of ways to process and represent data **SC4-WS-05**
* communicates scientific concepts and ideas using a range of communication forms **SC4-WS-08**

**Related Life Skills outcomes:** SCLS-FNS-01, SCLS-FNS-02, SCLS-WS-02, SCLS-WS-05, SCLS-WS-08

#### Content

**Working scientifically**

In this focus area, students develop skills in questioning and predicting, processing data and information, and communicating scientific ideas and concepts. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Questioning and predicting](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-2c2e8df0-8e99-4c98-b6f4-67f6d7b57e08), [Processing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-7d77e241-ccbe-4dfe-af35-5b0708d42909), [Communicating](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-e30ee5b9-e7cf-44ed-8d39-a7a227af3a4c)

##### Body systems

* Explain the interrelationship among cells, tissues and organs
* Identify the role of the digestive, circulatory, respiratory and excretory systems of humans, and name the major organs
* Draw or annotate representations of models of organ systems to describe their processes and functions
* Describe how the structures of organ systems, and the specialised cells within these systems, enable them to carry out their functions

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| **Example(s):**  The villi in the small intestine have specialised cells that help absorb nutrients during digestion. |

* Explain how a disorder or disease affecting the components of a body system, or the removal of any component in the body system, impacts on the overall functioning of the system and the organism as a whole

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| **Example(s):**  The removal or loss of function of part of a body system, such as the spleen or gall bladder. |

* Describe how the components of each body system interact to allow the efficient functioning of an organism

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| **Example(s):**  The epiglottis protects the airways during swallowing. |

##### Plant systems

* Determine the role, structure and function of the components of a plant, including the xylem and phloem, in maintaining plants as multicellular organisms

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| **Example(s):**  Plant dissection to observe the roots, flowers, stems and leaves of plants; placing a plant stem in water with food colouring will allow for transpiration and the observation of xylem (the vascular tissue) which is responsible for the conduction of water. |

* Use scientific tools and instruments to observe the specialised cells and tissues involved in the structure and function of plants

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| **Example(s):**  Microscopes, plant models, diagrams, images and/or simulations to examine the specialised structures of plants. |

##### Ecosystems

* Identify the components that make up an ecosystem

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| **Example(s):**  The biotic and abiotic components of an ecosystem. |

* Investigate the interactions of biotic and abiotic factors in an ecosystem

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| **Example(s):**  Non-living (abiotic) factors, such as sunlight, influence living (biotic) organisms, such as plants, animals, microorganisms. |

* Identify how matter and energy are cycled through an ecosystem
* Create a food web and ecological energy pyramid based on local area observations to describe how matter and energy move through an ecosystem
* Create written texts to explain how energy pyramids show the amount of energy or matter at each trophic level

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| **Example(s):**  A written text could include a factual description or a descriptive report. |

* Examine secondary-source data on the factors that change populations, including the introduction of a new species to an ecosystem, to identify trends, patterns and relationships, and draw conclusions

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| **Example(s):**  Causes of change include seasonal change or destruction of habitat.  Population changes might include: the mass extinction of species, such as in the case of the dodo (*Raphus cucullatus*); functional and human-led extinction, such as in the case of the Tasmanian tiger (*Thylacinus cynocephalus*); small-scale extinction of a specific species, such as in the case of the Bramble Cay melomys (*Melomys rubicola*). |

##### Living systems in context

* Investigate factors that lead to a species becoming endangered or extinct to explain why Australia has some of the world’s highest rates of species population decline and extinction

### Periodic table and atomic structure

#### Outcomes

A student:

* explains how uses of elements and compounds are influenced by scientific understanding and discoveries relating to their properties **SC4-PRT-01**
* uses a variety of ways to process and represent data **SC4-WS-05**
* uses data to identify trends, patterns and relationships, and draw conclusions **SC4-WS-06**

**Related Life Skills outcomes:** SCLS-SOL-01, SCLS-WS-05, SCLS-WS-06

#### Content

**Working scientifically**

In this focus area, students develop skills in processing and analysing data and information. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Processing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-7d77e241-ccbe-4dfe-af35-5b0708d42909), [Analysing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-026b93d6-b1da-454c-a537-852180ad8fcf)

##### Classification of matter

* Identify some common elements in everyday objects

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| **Example(s):**  Aluminium in soft drink cans, carbon in ‘lead’ pencils, copper in electrical wires, gold in jewellery, silicon in computer chips, tungsten in incandescent light bulbs. |

* Conduct a series of investigations to identify and compare the physical properties of metals, non-metals and metalloids

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| **Example(s):**  Properties, including heat and electrical conductivity, lustre, physical state, luminescence, melting point, boiling point, malleability, ductility. |

* Explain how the properties of some common elements, compounds and alloys relate to their use(s)

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| **Example(s):**  Aluminium is a lightweight non-corroding metal that is soft and malleable and used in cans, utensils, and airplane and automotive parts. |

##### Atomic structure

* Identify the atom as the smallest unit of an element that retains the properties of that element
* Identify protons, neutrons and electrons as subatomic particles
* Describe the location, relative charge and mass of protons, neutrons and electrons using the planetary atomic model
* Outline how models of atomic structure have changed over time
* Explain how observations made possible by new technologies have led to a more detailed understanding of atomic structure

##### Periodic table

* Outline patterns and relationships found in the periodic table, including reactivity

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| **Example(s):**  Rows are named periods, columns are named groups, and each group has similar properties. |

* Predict the properties of elements based on their position and location on the periodic table

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| **Example(s):**  The prediction that molybdenum (Mo) is shiny and silvery, as it is located in the metals section of the periodic table. |

* Identify the unique symbol of a range of elements

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| **Example(s):**  C is carbon, Mg is magnesium. Some symbols use the Latin name of the element to determine the symbol, such as Fe (*ferrum*) for iron, Na (*natrium*) for sodium, W (*wolfram*) for tungsten. |

* Use the periodic table to identify the elements in some common compounds

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| **Example(s):**  Water (H2O) is made from hydrogen and oxygen; methane (CH4) is made from hydrogen and carbon; carbon dioxide (CO2) is made from carbon and oxygen. |

* Investigate some tests that could be used to identify metal and non-metal elements

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| **Example(s):**  Flame tests could be used to identify some metals.  The ‘pop’ test could be used to identify hydrogen. |

* Model the atomic structure of the first 18 elements to identify that atomic structure changes with increasing atomic number

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| **Example(s):**  2D or 3D models of atoms. |

* Describe how the historical development of the periodic table demonstrated understanding of the chemical and physical properties of elements

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| **Example(s):**  A written text could be a factual recount or a sequential explanation. |

##### Periodic table and atomic structure in context

* Investigate how the properties and availability of materials, including metals, alloys and compounds, influence their uses

### Change

#### Outcomes

A student:

* explains how energy causes geological and chemical change **SC4-CHG-01**
* uses scientific tools and instruments for observations **SC4-WS-01**
* plans safe and valid investigations **SC4-WS-03**
* follows a planned procedure to undertake safe and valid investigations **SC4-WS-04**

**Related Life Skills outcomes:** SCLS-CHG-01, SCLS-EGU-01, SCLS-WS-01, SCLS-WS-03, SCLS-WS-04

#### Content

**Working scientifically**

In this focus area, students develop skills in observation, as well as planning and conducting investigations. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Observing](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-f27d1490-503e-46a1-879f-363fec4184f5), [Planning investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-0b1df83b-3056-4e12-be95-92bd29554af8), [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-ff323f4e-b0af-4931-879e-81036e19cca0)

##### Energy transfers

* Identify conduction, convection and radiation as different ways that energy can be transferred, and distinguish between these forms
* Describe, using the terms ‘potential energy’ (PE) or ‘kinetic energy’ (KE), how systems can store different forms of energy, including thermal, elastic, chemical and gravitational energy
* Identify examples of how energy can change from one form into another
* Use practical investigations and representations to illustrate energy transformations in a system

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| **Example(s):**  Flow diagrams, simulations, models. |

* Define open and closed systems to describe how energy is transferred into and out of systems, and how it cycles within a system
* Apply the law of conservation of energy to familiar examples
* Use representations to illustrate energy transformations, including how radiant energy from the Sun can be transformed into a different form of energy

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| **Example(s):**  Radiant energy from the Sun → absorption by a solar oven → conversion to thermal energy → energy used to cook food. |

##### Chemical change

* Undertake experiments to identify the indicators of physical and chemical changes

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| **Example(s):**  Seeing a flame or light, a colour change, or a substance appearing or disappearing; hearing new bubbles forming; measuring a change in temperature.  Data loggers and thermometers allow for observations to be made with tools. |

* Describe the initial and final changes that are observed in a chemical reaction, including writing a word equation to represent a chemical reaction

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| **Example(s):**  Burning silvery magnesium metal produces a brilliant white light and a white powder; magnesium + oxygen → magnesium oxide. |

* Investigate and observe energy changes in different chemical reactions
* Conduct a practical investigation to model cellular processes, including respiration and photosynthesis, and document findings in a written report

##### Geological change

* Describe the processes associated with the movement of tectonic plates

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| **Example(s):**  Tectonic plates move due to heat convection in the Earth’s mantle.  Ridge push, caused by gravitational force at the spreading ridges; slab pull, caused by gravitational force in subduction zones. |

* Identify the evidence used to develop the theory of plate tectonics

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| **Example(s):**  Similarities between Africa and South America, including their similar biogeography; how organisms evolved differently around the world; earthquakes, mountain building and volcanic activity at the boundaries of moving plates.  The geologist and oceanographic cartographer, Marie Tharp, created topographic maps of the Atlantic Ocean floor. |

* Identify that earthquakes and volcanoes are natural phenomena that provide evidence of geological changes in the Earth’s crust and surface
* Describe how Aboriginal and/or Aboriginal and Torres Strait Islander Cultural accounts provide evidence of earthquakes and volcanoes on‑Country or under the sea

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| **Example(s):**  The Awabakal and Worimi Peoples’ Dreaming story, ‘The Kangaroo that lives inside Nobbys’; the Bundjalung Peoples’ Dreaming stories about Wollumbin, such as stories of ‘the Warrior Chief' and ‘the Turkey’. |

* Conduct investigations or simulations to compare the observable properties of different types of minerals and rocks

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| **Example(s):**  Crystal sizes of sedimentary, igneous and metamorphic rocks.  Different types of rocks and minerals have different densities.  Most rocks are mixtures. |

* Use the rock cycle to explain the geological processes that lead to the formation and transformation of different types of rocks

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| **Example(s):**  The rock cycle involves a continuous series of geological processes, including the formation of igneous, sedimentary and metamorphic rocks, as rocks undergo changes in temperature, pressure, erosion, weathering and deposition. |

* Model the formation of fossils and explain how fossils show evidence that different organisms existed at different times in the past

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| **Example(s):**  Different fossil formations, including body, cast, trace, opalised and amber fossils.  Fossil evidence can be used to draw conclusions about how and when a rock was formed. |

* Recognise that the law of superposition allows scientists to determine the relative age of rock strata
* Describe the elemental composition of the Earth and one or more other planets

##### Change in context

* Observe or design a chain reaction machine to represent energy stores and explain the transfers in the system

### Data science 1

#### Outcomes

A student:

* explains how data is used by scientists to model and predict scientific phenomena **SC4-DA1-01**
* uses data to identify trends, patterns and relationships, and draw conclusions **SC4-WS-06**
* identifies problem-solving strategies and proposes solutions **SC4-WS-07**

**Related Life Skills outcomes:** SCLS-DAS-01, SCLS-WS-06, SCLS-WS-07

#### Content

**Working scientifically**

In this focus area, students develop skills in analysing data and information, as well as identifying problem-solving strategies and proposing solutions to problems. Additional Working scientifically outcomes and skills may be integrated with this content**.**

**Related**: [Analysing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-026b93d6-b1da-454c-a537-852180ad8fcf), [Problem-solving](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-4/faa7a5c228#cg-b59220b0-28b4-49c0-9e22-69796d0d5ed5)

##### Data science context

The Data science focus area can be taught alongside other focus areas, or aligned to students’ interests, local context or school environment.

##### Data

* Examine a range of sources of data and their applications

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| **Example(s):**  Data sources, including big data, experimental data, websites, digital technology. |

* Examine the digital footprint created by different online activities to recognise the importance of engaging safely with digital systems

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| **Example(s):**  Posting on social media, subscribing to a newsletter, leaving an online review, shopping online. |

* Recognise that data science is an interdisciplinary field that uses statistics, scientific methods and processes, algorithms and systems to develop knowledge by extracting or extrapolating insights from data

##### Scientific models

* Compare and contrast scientific inquiries of natural phenomena with nonscientific approaches

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| **Example(s):**  Evidence-based medicine compared to the non-scientific approach of iridology; neuroscience compared to phrenology (a pseudoscience). |

* Identify that a scientific model is a representation based on data and observations of real-world phenomena

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| **Example(s):**  Models of the Solar System; a particle model of matter; the atomic structure model. |

* Identify examples of the types of models used by scientists

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| **Example(s):**  Diagrams, physical 3D models, computer simulations, mathematical formulas. |

* Analyse a model to identify data and trends, and generate predictions

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| **Example(s):**  Examine a weather model to find patterns in temperature data and make forecasts about upcoming weather conditions. |

* Identify that computer-based models enable phenomena to be simulated, and variables can be easily changed to investigate their effect

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| **Example(s):**  Geological models of the changes to the Earth’s surface; weather forecasting models. |

##### Applications of models

* Identify data and observations used by scientists for the development of a model

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| **Example(s):**  The Big Bang model. |

* Outline how scientists develop workable theories from models

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| **Example(s):**  How astronomers developed workable theories about how the Universe came to be. |

##### Collecting, using and analysing datasets

* Formulate and investigate scientific questions that can be addressed with data

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| **Example(s):**  Investigations to collect datasets, such as class data, survey data, fieldwork datasets, first-hand collection of experimental data. |

* Conduct repeated experimental trials to calculate and compare the mean and range of data collected by different groups to discuss the accuracy and reliability of experimental data

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| **Example(s):**  Compare data collected in small groups to class sets of data. |

* Analyse data collected from a range of student investigations to look for patterns and test whether data is consistent with an initial prediction

##### Data science 1 in context

* Create a model that can be used to explain an observable phenomenon

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| **Example(s):**  A scientific model can be a visual, mathematical or computer model. |

## Outcomes and content for Stage 5

### Working scientifically

#### Outcomes

A student:

* selects and uses scientific tools and instruments for accurate observations **SC5-WS-01**
* develops questions and hypotheses for scientific investigation **SC5-WS-02**
* designs safe, ethical, valid and reliable investigations **SC5-WS-03**
* follows a planned procedure to undertake safe, ethical, valid and reliable investigations **SC5-WS-04**
* selects and uses a range of tools to process and represent data **SC5-WS-05**
* analyses data from investigations to identify trends, patterns and relationships, and draws conclusions **SC5-WS-06**
* selects suitable problem-solving strategies and evaluates proposed solutions to identified problems **SC5-WS-07**
* communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **SC5-WS-08**

**Related Life Skills outcomes:** SCLS-WS-01, SCLS-WS-02, SCLS-WS-03, SCLS-WS-04, SCLS-WS-05, SCLS-WS-06, SCLS-WS-07, SCLS-WS-08

#### Content

##### Observing

* Select and use equipment correctly, including digital technologies, to make observations to increase the accuracy of measurements appropriate to the task
* Make a series of observations with precision

##### Questioning and predicting

* Formulate questions or hypotheses that can be investigated scientifically
* Predict outcomes based on observations and scientific knowledge

##### Planning investigations

* Describe the purpose of an investigation
* Explain the use of variables and experimental controls in a valid scientific investigation
* Assess the types of data that need to be collected in a range of investigation types
* Select and explain investigation methods, including fieldwork and laboratory experimentation, to collect reliable data
* Identify risks, consider ethical issues and select suitable materials and technologies for a range of investigations
* Modify an investigation in response to new evidence

##### Conducting investigations

* Implement safe work practices and manage risks
* Assemble, construct and manipulate identified equipment to perform the investigation
* Follow the planned procedure and identify and respond to errors if they occur
* Systematically and accurately collect and record data, information, evidence and findings
* Extract information from a wide range of reliable secondary sources and acknowledge these sources using an accepted referencing style

##### Processing data and information

* Select and use a range of representations to organise data and information, including graphs, keys, models, diagrams, tables and spreadsheets
* Select and extract information from texts, diagrams, flow charts, tables, databases, graphs and multimedia resources
* Calculate a range of descriptive statistics using SI units
* Identify data which supports or refutes questions, hypotheses and proposed solutions to problems
* Describe specific ways to improve the quality of data collected in an investigation

##### Analysing data and information

* Describe patterns and trends, including inconsistencies in data and information
* Describe relationships between variables
* Assess the validity and reliability of first-hand data
* Use graphed data from investigations to extrapolate or interpolate information to make predictions
* Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
* Synthesise data and information to develop evidence-based arguments
* Evaluate conclusions and evidence, including identifying sources of uncertainty and possible alternative explanations
* Analyse the validity of information from secondary sources

##### Problem-solving

* Select suitable strategies and implement them to solve an identified problem
* Develop evaluation criteria relevant to identified problems
* Assess the solutions proposed based on the relevant evaluation criteria
* Use cause-and-effect relationships and models to explain ideas and make predictions
* Evaluate different approaches used to solve problems
* Evaluate claims using scientific knowledge and findings from investigations

##### Communicating

* Present scientific arguments using evidence, correct scientific language and terminology, as appropriate to audience and purpose
* Create written texts to communicate scientific investigations, explain scientific theories and principles, structure a scientific argument, and evaluate findings in light of scientific knowledge
* Recognise that scientific texts develop arguments by encouraging the reader to adopt a specific perspective and positioning them to accept the authority of a text

### Energy

#### Outcomes

A student:

* evaluates current and alternative energy use based on ethical and sustainability considerations **SC5-EGY-01**
* selects and uses scientific tools and instruments for accurate observations **SC5-WS-01**
* follows a planned procedure to undertake safe, ethical, valid and reliable investigations **SC5-WS-04**
* selects suitable problem-solving strategies and evaluates proposed solutions to identified problems **SC5-WS-07**

**Related Life Skills outcomes:** SCLS-EGU-01, SCLS-WS-01, SCLS-WS-04, SCLS-WS-07

#### Content

**Working scientifically**

In this focus area, students develop skills in selecting and using scientific tools for accurate observations, as well as conducting investigations and problem-solving. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Observing](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-7bd414b3-4dd8-46eb-9d1d-62cab140731e), [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-33f0f9a3-5b9a-42bf-a392-67bafc243cb4), [Problem-solving](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-6fb1fdb5-432a-4b00-a2b2-2d8b5a82c446)

##### Law of conservation of energy

* Use the law of conservation of energy, and calculations, to explain that total energy is maintained in energy transfers and transformations in a closed system
* Explain efficiency in relation to energy transfers
* Explain how to improve energy efficiency in energy transfers and transformations

##### Sources of energy

* Identify different types of energy sources

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| **Example(s):**  Biogas, biomass, coal, crude oil, gas, geothermal, nuclear, solar, wind. |

* Describe how electrical energy can be produced from different types of sources
* Evaluate the advantages and disadvantages of using renewable and non-renewable sources of energy to generate electricity, including efficiency, economical and technological considerations

##### Electrical energy

* Identify the elements of a complete circuit

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| **Example(s):**  Conductive path, source of electrical power, load; a switch is an optional component. |

* Construct circuits and draw circuit diagrams that contain several components to show the flow of electricity through a complete circuit
* Measure and compare voltage and current at different points in series and parallel circuits
* Conduct an investigation to determine the relationship between voltage (),   
  current (), and resistance (), as described by Ohm’s law ()
* Conduct an investigation to compare the energy transformed over time in model circuits or appliances

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| **Example(s):**  Using a plug power meter, heating water. |

* Investigate the energy star ratings of a range of appliances and explain the criteria used to determine these ratings

##### Global future energy needs

* Evaluate ways to optimise current energy use
* Examine data to identify past trends in energy use, and predict possible future demands, at a state, national and global level
* Explain reasons for the development of alternative sources of energy

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| **Example(s):**  The current dependency on rapidly dwindling sources of energy; the burning of fossil fuels that release carbon dioxide into the atmosphere and contribute to the greenhouse effect and climate change. |

##### Energy in context

* Use data, evidence and research to evaluate the development of alternative energy sources to meet and reduce global energy demand

### Disease

#### Outcomes

A student:

* explains how an understanding of the causes of disease can be used to prevent and manage the spread of disease **SC5-DIS-01**
* analyses data from investigations to identify trends, patterns and relationships, and draws conclusions **SC5-WS-06**
* communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **SC5-WS-08**

**Related Life Skills outcomes:** SCLS-DIS-01, SCLS-WS-06, SCLS-WS-08

#### Content

**Working scientifically**

In this focus area, students develop skills in analysing data and information, as well as communicating scientific arguments with evidence. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Analysing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-56599111-6233-4e8d-95d0-2a3cfad6276a), [Communicating](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-fd19e196-1604-4a68-840a-924f665e54d4)

##### Homeostasis

* Identify the importance of maintaining stable internal conditions in the body

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| **Example(s):**  Temperature, pH, hormone levels. |

* Investigate examples of an organism’s observable response to a stimuli

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| **Example(s):**  The dilation of the pupil in response to light. |

* Identify the role of feedback loops in maintaining homeostasis

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| **Example(s):**  Temperature regulation (negative feedback); blood clotting following a wound (positive feedback). |

* Compare and contrast the responses of the nervous and endocrine systems
* Describe how the nervous and endocrine systems coordinate the body’s response to stimuli

##### Infectious and non-infectious diseases

* Distinguish between infectious and non-infectious diseases
* Identify causes of non-infectious and infectious diseases

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| **Example(s):**  Non-infectious diseases can be caused by genetics, environmental factors or nutritional diseases.  Infectious diseases are caused by pathogens. |

* Compare the features and incidences of epidemics, endemics and pandemics
* Investigate data relating to a common non-infectious disease affecting Australians today

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| **Example(s):**  Interpreting tabulated and graphical data that display rates of a specific non-infectious disease; interpreting graphs to identify trends in incidence of a named non-infectious disease.  Non-infectious diseases could include Type 2 diabetes, cancers, heart disease, stroke. |

* Use modelling to investigate how infectious diseases can be spread

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| **Example(s):**  The spread of infectious diseases can be modelled using sodium hydroxide (NaOH) and water/phenolphthalein, or by using an online simulation. |

* Identify how the body prevents the entry of pathogens and describe how it responds to pathogens that enter the body
* Outline how a vaccination stimulates the body to produce antibodies to fight infection

##### Disease control and prevention

* Describe ways to reduce the incidence of non-infectious diseases

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| **Example(s):**  Public health measures including educating the public about the risks of smoking and e-cigarettes, enforcing tobacco control policies, promoting healthy lifestyles, and ensuring access to healthcare. |

* Assess ways to reduce the incidence and spread of infectious diseases

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| **Example(s):**  Public health campaigns about personal hygiene, quarantine, education, medical treatments. |

* Investigate Aboriginal and/or Torres Strait Islander Peoples’ use of plants to prevent or control disease

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| **Example(s):**  The Bundjalung People use tea tree oil to treat wounds; the Gumbaynggirr People use the sap of bloodwood trees as an antiseptic. |

* Analyse data about immunisation programs and the occurrence of infectious diseases to identify trends, patterns and relationships, and document conclusions in a written text

##### Disease in context

* Investigate technological advances developed in Australia to address disease, disorders or physical trauma in the human body

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| **Example(s):**  Fiona Wood's spray-on skin technique to treat physical trauma; epidemiologist Professor Fiona Stanley, who identified the factors contributing to neural tube defects and childhood diseases; Professor Elizabeth Blackburn, who was awarded the 2009 Nobel Prize in Physiology or Medicine for her discoveries related to telomeres, which are essential for understanding aging and disease; Monash Vision Group's work on the bionic eye. |

### Materials

#### Outcomes

A student:

* assesses the uses of materials based on their physical and chemical properties **SC5-MAT-01**
* designs safe, ethical, valid and reliable investigations **SC5-WS-03**
* selects suitable problem-solving strategies and evaluates proposed solutions to identified problems **SC5-WS-07**
* communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **SC5-WS-08**

**Related Life Skills outcomes:** SCLS-RES-01, SCLS-RES-02, SCLS-WS-03, SCLS-WS-07, SCLS-WS-08

#### Content

**Working scientifically**

In this focus area, students develop skills in planning investigations, problem-solving and communication skills. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Planning investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-95659659-770b-43b4-913d-d306fd47ec4f), [Problem-solving](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-6fb1fdb5-432a-4b00-a2b2-2d8b5a82c446), [Communicating](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-fd19e196-1604-4a68-840a-924f665e54d4)

##### Resources

* Identify the finite nature of the minerals and resources extracted in Australia
* Investigate the products produced from Australian minerals and resources

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| **Example(s):**  Coal is used in electricity generation; iron ore is used to produce steel; bauxite is used to produce aluminium. |

* Explain how Aboriginal and Torres Strait Islander Peoples used minerals and resources for a wide range of purposes

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| **Example(s):**  Resin is used: as an adhesive when manufacturing, maintaining and repairing implements; as a waterproofing agent; as fuel for a torch; to add strength to a join.  Minerals such as hematite (Fe2O3) can be formed into red ochre to produce coloured pigments for painting and ceremonies. |

* Evaluate the environmental impact of extracting and using a named resource and document findings in a written scientific report

##### Bonding

* Use valency to describe the number of electrons an atom needs to gain, lose or share to achieve a stable electron configuration
* Explain noble gas configuration and identify that it occurs during chemical bonding
* Describe types of chemical bonds, including ionic, covalent and metallic bonds
* Use models to describe the formation of cations and anions
* Recognise that some elements exist as diatomic molecules

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| **Example(s):**  Bromine (Br2), iodine (I2), nitrogen (N2), chlorine (Cl2), hydrogen (H2), oxygen (O2), fluorine (F2). |

* Construct chemical formulas of some common ionic compounds and covalent molecules

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| **Example(s):**  Sodium chloride (NaCl), magnesium oxide (MgO), water (H2O), carbon dioxide (CO2). |

* Conduct an investigation to observe and compare the physical and chemical properties of ionic, covalent and metallic substances, and explain how these relate to their uses

##### Chemistry of organic compounds

* Distinguish between organic and inorganic compounds
* Describe how hydrocarbons can be separated from crude oil and identify the uses of these products

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| **Example(s):**  Crude oil can be separated through the process of fractional distillation.  Uses include the creation of fuels, asphalt, clothing, polymers. |

* Use International Union of Pure and Applied Chemistry (IUPAC) nomenclature to name simple organic compounds

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| **Example(s):**  Simple organic molecules, such as ethane, ethanol and ethanoic acid. |

* Identify and reproduce the structure of simple alkanes C1–C8

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| **Example(s):**  Simple alkanes are straight-chained, non-branched hydrocarbons with single bonds only. |

* Describe the differences between complete and incomplete combustion reactions of hydrocarbons, and use examples from everyday applications to compare the products of the chemical reaction and amount of energy released

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| **Example(s):**  Observe a Bunsen burner flame with the collar open (complete combustion) and with the collar closed (incomplete combustion). |

* Research the uses of hydrocarbon compounds and how this has changed over time

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| **Example(s):**  Cars run on hydrocarbon fuels; hydrocarbons are used as engine lubricants; many common polymers are derived from hydrocarbons; clothing is made from hydrocarbons. |

##### Polymers

* Identify the raw materials used to make polymers

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| **Example(s):**  One example of a simple polymer is polyethylene, which is made from the raw material ethene. This versatile polymer is used in various forms, including low-density polyethylene (LDPE) and high-density polyethylene (HDPE). |

* Investigate and describe the properties of a range of polymers
* Determine the quantity and types of polymers found in the environment by undertaking a physical survey of the local area

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| **Example(s):**  The local school grounds, a nearby nature area or playground, the fridge or pantry at home. |

* Conduct an investigation to determine the biodegradability of different packaging materials
* Investigate case studies to explain the effect of bioaccumulation of microplastics in the environment

##### Materials in context

* Assess the environmental impacts of materials that are used as alternatives to those derived from crude oil

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| **Example(s):**  Replacing single-use plastic straws with paper straws. |

### Environmental sustainability

#### Outcomes

A student:

* analyses the impact of human activity on the natural world **SC5-ENV-01**
* analyses data from investigations to identify trends, patterns and relationships, and draws conclusions **SC5-WS-06**
* selects suitable problem-solving strategies and evaluates proposed solutions to identified problems **SC5-WS-07**

**Related Life Skills outcomes:** SCLS-RES-01, SCLS-RES-02, SCLS-WS-06, SCLS-WS-07

#### Content

**Working scientifically**

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##### Sustainability

* Identify the principles and goals of sustainability

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| **Example(s):**  The principles and goals of sustainability aim to promote the responsible and ethical use of resources, protect the environment and ensure a high quality of life for present and future generations. |

* Apply scientific understanding to propose valid solutions to identified problems relating to sustainability

##### Climate science

* Distinguish between climate and weather
* Investigate data to determine what trends are evident in the world’s climate
* Explain how the natural greenhouse effect influences global climate

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| **Example(s):**  Ice core samples can be used as evidence of increasing carbon dioxide levels over time. |

* Analyse data on global emissions and atmospheric temperatures to explain the enhanced greenhouse effect and its impact on climate and ecosystems

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| **Example(s):**  Arctic ecosystems, ocean ecosystems and Australian ecosystems. |

* Identify the advantages and limitations of methods used to reduce greenhouse gas emissions
* Analyse data that shows the relationship between industrialisation and the rise in global temperatures

##### Impacts of present-day climate change

* Identify the characteristics of climate change

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| **Example(s):**  Characteristics of climate change, including global temperature increases, weather pattern variations, the melting of polar ice caps, rising sea levels. |

* Investigate and report on the consequences of climate change

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| **Example(s):**  That temperature increases cause shifts in precipitation and snow cover patterns.  The likely increases in the frequency of flooding and drought.  The impacts of ocean acidity on ecosystems. |

* Investigate the effects of climate change on the water cycle and ecosystems

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| **Example(s):**  Changes in ocean and atmospheric temperatures, sea levels, biodiversity, species distribution, permafrost, sea ice, ocean pH. |

* Investigate how satellites collect global data, including data on ocean temperatures, sea levels, and forest and ice cover, and examine how this data is used to evaluate the impact of climate change

##### Alternative resource use and recycling

* Describe the causes of environmental pollution and discuss its implications

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| **Example(s):**  Environmental pollution is the addition of any substance, or any form of energy, such as heat, sound or radioactivity, to the environment at a rate faster than it can be dispersed, diluted, decomposed or recycled. |

* Research how Aboriginal and Torres Strait Islander Peoples have developed sustainable harvesting practices and Cultural protocols based on deep ecological understandings
* Discuss alternatives to the current resource use, including how to reduce, reuse and recycle
* Describe current processes for recycling materials
* Investigate how scientists have developed innovative ways to recycle materials

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| **Example(s):**  Veena Sahajwalla's methods for recycling materials. |

##### Environmental sustainability in context

* Discuss the link between human activity and one specific environmental pollution concern

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| **Example(s):**  Space junk, oceanic garbage patch. |

### Genetics and evolutionary change

#### Outcomes

A student:

* describes the relationship between the diversity of living things and the theory of evolution **SC5-GEV-01**
* explains how DNA is responsible for the transmission of heritable characteristics and can be manipulated through genetic technologies **SC5-GEV-02**
* selects and uses a range of tools to process and represent data **SC5-WS-05**
* communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **SC5-WS-08**

**Related Life Skills outcomes:** SCLS-GEV-01, SCLS-FNS-01, SCLS-WS-05, SCLS-WS-08

#### Content

**Working scientifically**

In this focus area, students develop skills in processing data and information, as well as developing communication skills. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Processing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-75cbcdeb-3446-4b3e-b7ab-c794b95a0423), [Communicating](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-fd19e196-1604-4a68-840a-924f665e54d4)

##### DNA structure and function

* Identify that all organisms have information coded in genetic material
* Observe and model the arrangement of genetic information in an organism to define and compare the terms DNA, gene, chromosome and genome

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| **Example(s):**  DNA extraction from bananas, strawberries, kiwi fruits; prepared slides of cells undergoing division; molecular animations of chromosome organisation. |

* Relate the structure of the DNA double helix to its functions

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| **Example(s):**  Encoding instructions to make proteins, and for replication, which is essential for growth and reproduction. |

* Discuss the nature of scientific discovery by comparing the contributions of scientists involved in the discovery of the double helix structure of DNA

##### Variation and inheritance

* Outline how genetic information is passed on to offspring by sexual and asexual reproduction
* Identify that multiple genes and multiple environmental factors interact in the development of most traits
* Explain how DNA mutation can result in genetic variation with beneficial, harmful or minimal effects on the functioning of an organism
* Outline the connection between genotypes and phenotypes, using Mendelian inheritance for both plants and animals

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| **Example(s):**  Flower colour, freckles, dimples, widow’s peak. |

* Use pedigrees and Punnett squares to model monogenic gene-trait relationships and make predictions about patterns of inheritance

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| **Example(s):**  Pea plant traits, recessive genetic conditions. |

##### Genetic technologies

* Identify examples of current and emerging genetic technologies

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| **Example(s):**  The production of recombinant proteins, gene therapy. |

* Discuss applications of genetic technologies in conservation, agriculture, industry and medicine
* Discuss the applications of genetic testing and its associated social, economic and ethical implications

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| **Example(s):**  Tracing ancestry, genetic counselling, population screening, cancer treatment. |

##### The theory of evolution and evidence of natural selection

* Explain how the processes of natural selection and isolation can lead to changes within and between species

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| **Example(s):**  Variation occurs through mutation, meiosis, fertilisation.  Processes of natural selection, including competition, predation, ecosystem changes. |

* Investigate, using evidence, how the complexity and diversity of organisms have changed over geological timescales

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| **Example(s):**  Evidence, including from the fossil record. |

* Identify and discuss Aboriginal and/or Torres Strait Islander Peoples’ artwork that indicate changes in plants and animals, including megafauna

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| **Example(s):**  Various Aboriginal rock engravings and stories have depicted changes in plants and animals over time, including megafauna. |

* Discuss how scientists developed and refined the theory of evolution, and explain why an understanding of the origins of species is important

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| **Example(s):**  The anatomical similarities and differences of different species of Galapagos tortoises and Darwin’s finches; fossil observation; the biogeographical distribution of plant and animal species. |

##### Genetics and evolutionary change in context

* Use an ethical framework to construct evidence-based written arguments about the implications of a genetic technology, including the ethical implications of the continued use of the immortal HeLa cell line

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| **Example(s):**  An argument about CRISPR genetic engineering, constructed using a framework, such as the Nuremberg Code or the Declaration of Helsinki. |

### Reactions

#### Outcomes

A student:

* describes a range of reaction types **SC5-RXN-01**
* explains the factors that affect the rate of chemical reactions **SC5-RXN-02**
* selects and uses scientific tools and instruments for accurate observations **SC5-WS-01**
* develops questions and hypotheses for scientific investigation **SC5-WS-02**
* designs safe, ethical, valid and reliable investigations **SC5-WS-03**
* follows a planned procedure to undertake safe, ethical, valid and reliable investigations **SC5-WS-04**

**Related Life Skills outcomes:** SCLS-RXN-01, SCLS-WS-01, SCLS-WS-02, SCLS-WS-03, SCLS-WS-04

#### Content

**Working scientifically**

In this focus area, students develop skills in observation, as well as questioning and predicting, and planning investigations. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Observing](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-7bd414b3-4dd8-46eb-9d1d-62cab140731e), [Questioning and predicting](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-cffc1c81-4c66-4fd5-882d-d86155df97bb), [Planning investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-95659659-770b-43b4-913d-d306fd47ec4f), [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-33f0f9a3-5b9a-42bf-a392-67bafc243cb4)

##### Law of conservation of mass

* Explain the meaning of the law of conservation of mass
* Conduct a practical investigation to demonstrate the law of conservation of mass in a chemical reaction

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| **Example(s):**  Ethanoic acid sodium bicarbonate in a conical flask with a balloon; copper silver nitrate; glow sticks demonstrating chemiluminescence. |

* Investigate and explain how mass is conserved in closed systems

##### Chemical reactions

* Use IUPAC naming conventions to construct the chemical formula for common ionic and covalent compounds
* Represent chemical reactions, by predicting products and writing word and balanced chemical equations with states, as they are encountered

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| **Example(s):**  Sodium chlorine → sodium chloride; 2Na(s) Cl2(g) → 2NaCl(s).  The Activity series of metals diagram in the Science 7–10 Data Book can be used to predict if single displacement reactions will occur; the Solubility table in the Science 7–10 Data Book can be used to determine if a precipitate will form in a double displacement reaction. |

* Model simple chemical reactions to show that atoms are rearranged and mass is conserved during a reaction

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| **Example(s):**  Molecular modelling kits, diagrams or simulations. |

* Determine the features of reactions by conducting synthesis, decomposition, displacement and neutralisation reactions
* Identify pH as the measure of acidity and compare the pH of a range of common substances to the pH of pure water

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| **Example(s):**  Common substances, including soft drinks, cleaning solutions, vinegar (ethanoic acid). |

* Use pH indicators or meters to measure the pH change of neutralisation reactions

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| **Example(s):**  Indicators, such as phenolphthalein; methyl orange; bromothymol blue; universal indicator or those listed in the Science 7–10 Data Book, Acid to base indicators table; natural indicators, such as red cabbage and hydrangea flowers. |

##### Rate of chemical reactions

* Investigate and explain how concentration, surface area, temperature and catalysts affect the rate of reactions

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| **Example(s):**  Using effervescent tablets to change surface area by testing whole, broken and crushed tablets.  Concentration (g/L, % w/v), surface area (crushed compared to powdered tablets), temperature (comparing measured hot and cold reaction times), catalysts could include enzymes. |

* Conduct a practical investigation to test a measurable hypothesis, with a cause-and-effect relationship, that predicts changes to the rate of a chemical reaction, and graph data that communicates the investigation findings in a scientific report

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| **Example(s):**  A hypothesis for a reaction of ethanoic acid sodium bicarbonate → sodium ethanoate water carbon dioxide could be expressed as ‘the volume of gas will decrease when the concentration of ethanoic acid decreases’. |

##### Nuclear reactions

* Outline how the first elements were formed after the Big Bang
* Describe the conditions that cause a nucleus to be unstable
* Represent alpha and beta reactions as nuclear reactions

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| **Example(s):**  Alpha decay such as  , or   Beta decay such as  , or |

* Identify that the half-life of a radioactive isotope is the time taken for half of the atoms in a sample to undergo radioactive decay

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| **Example(s):**  The half-life for uranium-238 is 4.5 billion years, carbon-14 is 5700 years, technetium-99m is 6 hours.  A simple decay curve, such as the one in the Science 7–10 Data Book can show the decrease over time in the number of radioactive atoms or the intensity of radiation emitted by a radioactive substance. |

* Evaluate the societal benefits and considerations of using radioisotopes in medicine, industry and environmental monitoring

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| **Example(s):**  Fluorine-18 and technetium-99m are used for medical diagnostics; gold-198 is used to trace factory waste which causes ocean pollution; cobalt-60 is used in gamma irradiation; iodine-131 is used to treat thyroid cancer and hyperthyroidism; lutetium-177 is used for treatment of neuroendocrine cancer; americium-241 is used in smoke detectors. |

* Describe nuclear fission and nuclear fusion
* Outline the impacts on the environment of nuclear reactions, including the raw materials used, the various stages of production and nuclear waste

##### Reactions in context

* Investigate a chemical or nuclear reaction used in industry to produce an important product

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| **Example(s):**  Polymers, aspirin, sulfuric acid, medical isotopes, ammonia. |

### Waves and motion

#### Outcomes

A student:

* describes the features and applications of different forms of waves **SC5-WAM-01**
* explains the motion of objects using Newton’s laws of motion **SC5-WAM-02**
* follows a planned procedure to undertake safe, ethical, valid and reliable investigations **SC5-WS-04**
* selects and uses a range of tools to process and represent data **SC5-WS-05**

**Related Life Skills outcomes:** SCLS-WAM-01, SCLS-WS-04, SCLS-WS-05

#### Content

**Working scientifically**

In this focus area, students develop skills in conducting investigations, as well as processing data and information. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Conducting investigations](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-33f0f9a3-5b9a-42bf-a392-67bafc243cb4), [Processing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-75cbcdeb-3446-4b3e-b7ab-c794b95a0423)

##### Common properties of waves

* Demonstrate that a mechanical wave requires a medium to travel through, while an electromagnetic (EM) wave does not
* Use the wave model to explain how energy is transferred without the net transfer of particles
* Use models to compare and describe the features of transverse and longitudinal waves
* Compare the different wave forms of the electromagnetic spectrum
* Investigate the features of waves, including amplitude, frequency, speed and wavelength by exploring a range of wave types
* Use the formula to explain the relationship between a wave’s frequency, speed and wavelength

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| **Example(s):**  Wavelength is equal to the wave velocity divided by frequency. |

* Analyse data from secondary sources to compare the uses of different EM waves based on their properties

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| **Example(s):**  EM waves are used in medicine, sanitation, communication. |

##### Sound waves

* Model the transfer of sound energy as compressions and rarefactions in waves

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| **Example(s):**  Using metal springs. |

* Investigate and describe how amplitude and frequency affect the pitch and volume of sound
* Investigate the Doppler effect of waves
* Describe how the ear responds to sound waves
* Investigate and outline the impact of material selection on the transfer of sound energy in Aboriginal and/or Torres Strait Islander Peoples’ traditional musical and communication instruments

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| **Example(s):**  Didgeridoo, clapsticks, emu caller. |

* Describe how sound waves are used in medical diagnosis

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| **Example(s):**  Ultrasound is used in medical diagnosis to visualise internal structures and monitor foetal development using high-frequency sound waves; Doppler ultrasound is used to assess blood flow and detect vascular issues by measuring changes in the frequency of sound waves reflected from moving blood cells. |

##### Light waves

* Describe how the eye responds to light
* Investigate the properties of light, including absorption, reflection, refraction and scattering

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| **Example(s):**  Investigating ray boxes, mirrors and different media, or by using interactive materials, such as a simulation. |

* Investigate applications of absorption, reflection and refraction in everyday life
* Explain how the electromagnetic spectrum is used to learn about stars

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| **Example(s):**  A star’s colour provides a direct measurement of its surface temperature. |

##### Motion

* Conduct an investigation to analyse the relationships between distance, time, speed, displacement and velocity
* Investigate the motion of objects and represent them using motion diagrams

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| **Example(s):**  Using light gates, ticker timers, crash carts, rolling model cars across a floor to measure distance and time. |

* Conduct investigations to analyse the relationship between distance, time and speed, and draw and analyse a line graph of the results
* Conduct an investigation to analyse the relationships between force, mass and acceleration

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| **Example(s):**  Pulleys attached to masses and ticker timers, light gates or other sensors. |

* Investigate applications of Newton’s laws of motion
* Determine, using vector analysis, the net force on an object in one dimension
* Use mathematical representations, including graphs and the algebraic formulas , and , to quantitatively relate force, distance, time, speed, displacement, acceleration, velocity and mass

##### Waves and motion in context

* Structure an argument to analyse how waves and motion have changed society

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| **Example(s):**  Rockets deliver satellites to space which allows for use of mobile phones and GPS; radio telescopes communicate with satellites; optical fibres in medicine (endoscopes) and communication (high-speed internet). |

### Data science 2

#### Outcomes

A student:

* assesses the use of scientific knowledge and data in evidence-based decisions and when verifying the legitimacy of claims **SC5-DA2-01**
* analyses data from investigations to identify trends, patterns and relationships, and draws conclusions **SC5-WS-06**
* selects suitable problem-solving strategies and evaluates proposed solutions to identified problems **SC5-WS-07**
* communicates scientific arguments with evidence, using scientific language and terminology in a range of communication forms **SC5-WS-08**

**Related Life Skills outcomes:** SCLS-DAS-01, SCLS-WS-06, SCLS-WS-07, SCLS-WS-08

#### Content

**Working scientifically**

In this focus area, students develop skills in analysing data and information, problem-solving and communicating scientific arguments with evidence. Additional Working scientifically outcomes and skills may be integrated with this content.

**Related**: [Analysing data and information](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-56599111-6233-4e8d-95d0-2a3cfad6276a), [Problem-solving](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-6fb1fdb5-432a-4b00-a2b2-2d8b5a82c446), [Communicating](https://curriculum.nsw.edu.au/learning-areas/science/science-7-10-2023/content/stage-5/fa9f532d80#cg-fd19e196-1604-4a68-840a-924f665e54d4)

##### Data science context

The Data science focus area can be taught alongside other focus areas, or aligned to students’ interests, local context or school environment.

##### Investigating questions and claims

* Discuss the features of investigable and non-investigable questions, including considerations of available resources
* Investigate how scientific knowledge is verified and refined by scientists through hypothesis testing and peer review

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| **Example(s):**  Considerations of currency, credibility, consistency. |

* Develop criteria and use them to evaluate whether online content is valid and reliable
* Identify a claim that can be scientifically tested with an investigation, or series of investigations, to test the claim
* Explain the evidence and reasoning used to support conclusions about claims, using data from investigations

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| **Example(s):**  Consider how data processing, analysis and representation can affect the conclusions reached, and how data variation can indicate uncertainty and may influence the strength of the evidence and confidence of claims. |

* Conduct a written scientific argument showing how a range of evidence supports a claim

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| **Example(s):**  Multiple arguments relating to the age of the Universe. |

##### Pseudoscience

* Explain the distinction between science and pseudoscience using examples

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| **Example(s):**  Pseudoscience refers to claims presented as alternative explanations of natural phenomena that have not been developed using scientifically acceptable approaches. |

* Identify examples of pseudoscientific claims

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| **Example(s):**  Astrology, cryptozoology, flat-Earth theory, ‘water witching’ (dowsing). |

* Investigate incidences of pseudoscience in popular media
* Investigate how data, or its analysis and interpretation, can be distorted to manipulate findings that support specific viewpoints

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| **Example(s):**  Distorting a graph or visualisation. |

* Determine if an assertion of a claim or theory is pseudoscientific

##### Large datasets and scientific argumentation

* Outline the features, collection, uses and applications of large datasets

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| **Example(s):**  Datasets available from CSIRO, ANSTO or other reputable institutions. |

* Use available large datasets to develop and test a question
* Conduct a descriptive analysis of a large dataset
* Identify and outline the benefits of using descriptive statistical analysis techniques to assist in recognising or communicating patterns
* Conduct a univariate analysis and a bivariate analysis using large datasets

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| **Example(s):**  A univariate analysis could measure height; a bivariate analysis could measure the number of ice cream sales and temperature during summer. |

* Recognise the difference between causal and correlational relationships
* Explore the role of large datasets and statistical analysis in validating scientific findings

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| **Example(s):**  Gregor Mendel’s experiments with pea plants; astronomer Vera Rubin’s discovery of the existence of dark matter and how her claims were validated; global climate models. |

##### Data science 2 in context

* Use data to make evidence-based decisions about a familiar issue and assess the implications of these decisions

## Assessment

The primary role of assessment is to establish where students are in their learning so that teaching can be differentiated and further learning progress can be monitored over time. It provides information that assists teachers to target their teaching at the point of student need. Assessment is most effective when it is an integral part of teaching and learning programs.

Assessment involves:

* establishing where students are in their learning
* ongoing monitoring
* formative and summative tasks
* providing feedback about student progress.

### Common Grade Scale

**Stage 1, Stage 2, Stage 3, Stage 4, Stage 5**

The [common grade scale](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/understanding-the-curriculum/awarding-grades/common-grade-scale) can be used to report student achievement in both primary and junior secondary years in all NSW schools.

### Course performance descriptors

**Stage 5 – Year 10**

Course performance descriptors provide holistic descriptions of typical achievement at different grade levels in a specific course. They are used to identify and report a student’s level of achievement in a Board Developed Course at the end of Stage 5.

#### Grade A

A student performing at this grade typically:

* demonstrates extensive knowledge and understanding of scientific models, theories and laws
* applies extensive knowledge and understanding of the nature, use and practice of science in a range of contexts
* identifies and develops valid scientific hypotheses and questions to make evidence-based predictions
* designs appropriate, safe, ethical, valid and reliable scientific investigations and effectively follows plans to conduct investigations
* analyses data and synthesises information to draw evidence-based scientific conclusions about trends, patterns and relationships
* selects and applies a range of suitable problem-solving strategies and evaluates and compares proposed solutions to scientific problems
* communicates comprehensive scientific ideas and arguments using relevant scientific evidence, language and terminology appropriate to audience and purpose.

#### Grade B

A student performing at this grade typically:

* demonstrates thorough knowledge and understanding of scientific models, theories and laws
* applies thorough knowledge and understanding of the nature, use and practice of science in a range of contexts
* identifies and develops scientific hypotheses and questions to make logical predictions
* designs appropriate, safe, ethical, valid and reliable scientific investigations and follows plans to conduct investigations
* analyses data to draw evidence-based scientific conclusions about trends, patterns and relationships
* selects and applies a range of suitable problem-solving strategies and evaluates proposed solutions to scientific problems
* communicates scientific ideas and arguments using relevant scientific evidence, language and terminology appropriate to audience and purpose.

#### Grade C

A student performing at this grade typically:

* demonstrates sound knowledge and understanding of scientific models, theories and laws
* applies sound knowledge and understanding of the nature, use and practice of science in a range of contexts
* identifies and proposes scientific hypotheses and questions to make predictions
* designs safe, ethical and valid scientific investigations and follows plans to conduct investigations
* examines and uses data to draw scientific conclusions about trends, patterns and relationships
* selects and uses problem-solving strategies and evaluates proposed solutions to scientific problems
* communicates scientific ideas and arguments using scientific evidence, language and terminology appropriate to audience and/or purpose.

#### Grade D

A student performing at this grade typically:

* demonstrates basic knowledge and understanding of scientific models and/or theories and/or laws
* demonstrates basic knowledge and understanding of the use and practice of science
* asks scientific questions and makes predictions
* follows plans to conduct safe, ethical and valid scientific investigations
* outlines data to identify trends and/or patterns and/or relationships
* uses strategies to make observations about scientific problems
* communicates scientific ideas using some scientific language and terminology.

#### Grade E

A student performing at this grade typically:

* demonstrates elementary knowledge and/or understanding of some scientific principles or uses of science
* asks questions and/or identifies predictions
* conducts elements of safe and ethical scientific investigations
* identifies trends, patterns or relationships
* makes observations about given scientific problems
* communicates some scientific information.

### Assessment of Life Skills outcomes

**Stage 4, Stage 5**

The syllabus outcomes and content form the basis of learning opportunities for students. Through the [collaborative curriculum planning process](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/diversity-in-learning/special-education/collaborative-curriculum-planning), teachers select specific Life Skills outcomes which are based on the needs, strengths, goals, interests and prior learning of each student. Students are required to demonstrate achievement of one or more Life Skills outcomes.

Assessment should provide opportunities for students to demonstrate achievement in relation to the selected outcomes. Assessment can occur in a range of situations or environments such as the school and wider community. Evidence of achievement can be based on:

* [formative](https://curriculum.nsw.edu.au/assessment-and-reporting/formative-assessment) assessment opportunities
* [summative](https://curriculum.nsw.edu.au/assessment-and-reporting/summative-assessment) assessment opportunities.

There is no requirement for formal assessment of Life Skills outcomes. Stage 6 Life Skills courses do not have external examinations or mandatory projects.